

What is claimed:

1. A wear plate for use in combination with a centrifugal pump and impeller, comprising:
a wear surface defined by at least one of a substantially flat surface, a truncated conic section, and a curvilinear solid of revolution formed by revolving an area bounded by a curve
5 around a center axis of the wear plate,
one of a notch and recess provided in said wear plate wear surface,
wherein the notch or recess extends in at least one of a first direction perpendicular to predetermined direction of rotation of an impeller and a second direction crossing against a direction of rotation of said impeller.

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2. A wear plate for use in combination with a centrifugal pump and impeller, according to claim 1, wherein said second direction ranges from said first direction up to and including a direction opposite said direction of rotation.

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3. A wear plate for use in combination with a centrifugal pump and impeller according to claim 1, wherein the notch or recess extends along a longitudinal direction of said wear plate between an inner first radius of said wear plate and an outer second radius.

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4. A wear plate for use in combination with a centrifugal pump and impeller according to claim 1, wherein the notch or recess extends from an inner first radius of said wear plate to an outer second radius of said wear plate.

5. A wear plate for use in combination with a centrifugal pump and impeller according to claim 1, wherein said wear plate comprises a plurality of spaced apart notches or recesses.

6. A wear plate for use in combination with a centrifugal pump and impeller according to claim 5, wherein at least some of said plurality of spaced apart notches or recesses are disposed along a longitudinal direction of said wear plate between an inner first radius of said wear plate and an outer second radius in at least one of said first direction and said second direction..

7. A wear plate for use in combination with a centrifugal pump and impeller according to claim 6, wherein at least some of said plurality of spaced apart notches or recesses are spaced apart laterally along said wear surface of said wear plate.

8. A wear plate for use in combination with a centrifugal pump and impeller according to claim 5, wherein at least one of said plurality of spaced apart notches or recesses are contiguous with said inner first radius.

9. A wear plate for use in combination with a centrifugal pump and impeller according to claim 5, wherein a plurality of said spaced apart notches or recesses are contiguous with said inner first radius.

10. A wear plate for use in combination with a centrifugal pump and impeller according to claim 7, wherein said plurality of spaced apart notches are arranged in spaced apart groupings of plural notches.

11. A centrifugal pump impeller, comprising:
at least one vane disposed on said impeller;
a flange forming at least a portion of a working surface of said vane at an impeller to
5 wear plate interface and extending toward a high-pressure side of said vane.

12. A centrifugal pump impeller according to claim 11, wherein said vane comprises a
curvilinear and continuous vane extending from one edge of the centrifugal pump impeller
through a central portion of the impeller to another opposing edge of the impeller.

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13. A centrifugal pump impeller according to claim 12, wherein a leading edge of said
curvilinear and continuous vane has, at least in a vicinity of a midpoint of said impeller, a
substantially constant thickness.

15 14. A centrifugal pump impeller according to claim 13, wherein said vane is symmetric.

15. A centrifugal pump impeller according to claim 13, wherein a height of said leading edge
relative to a bottom of said impeller increases continuously from an outer radius of said leading
edge to central region of said impeller.

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16. A centrifugal pump impeller according to claim 11, wherein said flange has an upper
surface defining an acute angle with a parallel to an axis of rotation of said impeller and a curved
bottom portion.

17. A centrifugal pump impeller according to claim 16, wherein said curved bottom portion has an angle β ranging between 180° and about 0° .
- 5 18. A centrifugal pump impeller according to claim 16, wherein said curved bottom portion has an angle β ranging between about 110° to 70° .
19. A centrifugal pump, comprising:
an impeller configured to rotate in a predetermined direction of rotation within said
10 centrifugal pump; and
a wear plate bearing a wear surface disposed opposite and adjacent said impeller, and
one of a notch and recess provided in said wear surface,
wherein the notch or recess extends in at least one of a first direction perpendicular to
predetermined direction of rotation of said impeller and a second direction crossing against a
15 direction of rotation of said impeller.
20. A centrifugal pump, according to claim 19, wherein said second direction ranges from said first direction up to and including a direction opposite said direction of rotation.
- 20 21. A centrifugal pump according to claim 19, wherein the notch or recess extends along a longitudinal direction of said wear plate between an inner first radius of said wear plate and an outer second radius.

22. A centrifugal pump according to claim 19, wherein the notch or recess extends from an inner first radius of said wear plate to an outer second radius of said wear plate.

23. A centrifugal pump according to claim 20, wherein said wear plate comprises a plurality
5 of spaced apart notches or recesses.

24. A centrifugal pump according to claim 23, wherein at least some of said plurality of spaced apart notches or recesses are disposed along a longitudinal direction of said wear plate between an inner first radius of said wear plate and an outer second radius in at least one of said
10 first direction and said second direction.

25. A centrifugal pump according to claim 23, wherein at least some of said plurality of spaced apart notches or recesses are spaced apart laterally along said wear surface of said wear plate.
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26. A centrifugal pump according to claim 20, wherein at least one of said plurality of spaced apart notches or recesses are contiguous with said inner first radius.

27. A centrifugal pump according to claim 26, wherein a plurality of said spaced apart
20 notches or recesses are contiguous with said inner first radius.

28. A centrifugal pump according to claim 27, wherein said plurality of spaced apart notches are arranged in spaced apart groupings of plural notches.

29. A centrifugal pump according to claim 19, wherein said impeller comprises a curvilinear continuous vane extending from one edge of the impeller through a center portion of the impeller to another opposing edge of the impeller.

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30. A centrifugal pump according to claim 19, wherein said impeller comprises at least one vane having a flange provided at a working surface of said vane to form at least a portion of an impeller to wear plate interface and extending toward a high-pressure side of said vane.

10 31. A centrifugal pump according to claim 30, wherein said vane comprises a curvilinear and continuous vane extending from one edge of the centrifugal pump impeller through a central portion of the impeller to another opposing edge of the impeller.

32. A centrifugal pump according to claim 31, wherein said vane is symmetric.

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33. A centrifugal pump according to claim 32, wherein said flange is provided on substantially an entire working surface of said vane.

34. A centrifugal pump according to claim 32, wherein said flange is provided on a portion of
20 a working surface of said vane.

35. A centrifugal pump according to claim 32, wherein said flange has an upper surface defining an acute angle with a parallel to an axis of rotation of said impeller and a curved bottom portion.

5 36. A centrifugal pump according to claim 35, wherein said curved bottom portion has an angle β ranging between 180° and about 0° .

37. A centrifugal pump according to claim 35, wherein said curved bottom portion has an angle β ranging between about 110° to 70° .

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38. A centrifugal pump, comprising:

an impeller configured to rotate in a predetermined direction of rotation within said centrifugal pump, said impeller having at least one vane; and

15 a wear plate bearing a wear surface disposed opposite and adjacent said impeller, and one of a notch and recess having a first width provided in said wear surface,

wherein the notch or recess extends in at least one of a first direction perpendicular to predetermined direction of rotation of an impeller, a second direction having a component crossing against a direction of rotation of the impeller, and a third direction having a component in a direction of rotation of the impeller,

20 wherein said vane comprises a flange provided at a working surface of said vane to form at least a portion of an impeller to wear plate interface having a second width and extending toward a high-pressure side of said vane, and

wherein said second width is greater than said first width.

39. A centrifugal pump according to claim 38, wherein said vane comprises a curvilinear and continuous vane extending from one edge of the centrifugal pump impeller through a central portion of the impeller to another opposing edge of the impeller.

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40. A centrifugal pump according to claim 39, wherein said vane is symmetric.

41. A centrifugal pump according to claim 38, wherein said flange is provided on substantially an entire working surface of said vane.

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42. A centrifugal pump according to claim 38, wherein said flange is provided on a portion of a working surface of said vane.

43. A centrifugal pump according to claim 38, wherein said flange has an upper surface

15 defining an acute angle with a parallel to an axis of rotation of said impeller and a curved bottom portion.

44. A centrifugal pump according to claim 43, wherein said curved bottom portion has an angle β ranging between 180° and about 0° .

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45. A centrifugal pump according to claim 43, wherein said curved bottom portion has an angle β ranging between about 110° to 70° .

46. A wear plate for use in combination with a centrifugal pump and impeller according to claim 38, wherein said wear plate comprises a plurality of spaced apart notches or recesses.

47. A wear plate for use in combination with a centrifugal pump and impeller according to claim 46, wherein at least some of said plurality of spaced apart notches or recesses are disposed along a longitudinal direction of said wear plate between an inner first radius of said wear plate and an outer second radius in at least one of said first direction and said second direction..

48. A wear plate for use in combination with a centrifugal pump and impeller according to claim 46, wherein at least some of said plurality of spaced apart notches or recesses are spaced apart laterally along said wear surface of said wear plate.

49. A wear plate for use in combination with a centrifugal pump and impeller according to claim 46, wherein at least one of said plurality of spaced apart notches or recesses are contiguous with said inner first radius.

50. A wear plate for use in combination with a centrifugal pump and impeller according to claim 46, wherein a plurality of said spaced apart notches or recesses are contiguous with said inner first radius.

51. A centrifugal pump impeller, comprising:

at least one vane disposed on said impeller, said vane comprising a curvilinear and continuous vane extending from one edge of the centrifugal pump impeller through a central portion of the impeller to another opposing edge of the impeller,

wherein a leading edge of said curvilinear and continuous vane has, at least in a vicinity
5 of said central portion of said impeller, a substantially constant thickness.

wherein said vane is symmetric, and

wherein a height of said leading edge relative to a bottom of said impeller increases continuously from an outer radius of said leading edge to said central portion of said impeller.